

**Amendments to the Drawings:**

The three attached "Replacement Sheets" of drawings include changes to all drawing figures, as filed. These "Replacement Sheets" replace the three originally filed sheets of drawings. In all figures the "handwritten annotations" objected to by the Examiner have been replaced with "typewritten" Figure Headings. No new matter was added.

Attachment: three (3) Replacement Sheets with typewritten Figure Headings

## REMARKS

Before turning to the present Amendment which is filed in response to the Office Action, Applicants direct the Examiner's attention to the following issue.

The present application is the U.S. National Phase of International Application No. PCT/JP04/011894. Upon entry of the U.S. National Phase, Applicants submitted both a First Preliminary Amendment and a Second Preliminary Amendment. Applicants' undersigned attorney has checked the files available on the PAIR system of the U.S. Patent and Trademark Office, and both the First and Second Preliminary Amendments are properly of record in the prosecution file of the present application.

The First Preliminary Amendment was submitted merely for the purpose of canceling all multiple dependent claims (3-5 and 8-15) before calculation of the filing fee. In the Second Preliminary Amendment, Applicants re-entered the canceled claims re-written as new dependent claims 16-31. Thus, upon entry of both the First and Second Preliminary Amendments, claims 1, 2, 6, 7 and 16-31 are pending.

In the Office Action dated February 21, 2008, the Examiner failed to consider the claims (16-31) entered by the Second Preliminary Amendment. Accordingly, Applicants respectfully request the Examiner to consider the Second Preliminary Amendment before the present Amendment.

Turning to the present Amendment, claims 2, 7, 16, 19, 20, 22, 23, 25-27, 29 and 30 have been canceled. Accordingly, claims 1, 6, 17, 18, 21, 24, 28 and 31 are pending. Independent claim 1 has been amended to include the limitations of canceled claims 2 and 16, and independent claims 6 and 28 have been amended to include the limitations formerly stated in claims 7, 22, 23, 26 and 27. No new matter was added. For these reasons, Applicants

respectfully submit that the rejection based on the prior art of record has been overcome. Therefore, Applicants respectfully submit that the present application is in condition for allowance.

## **I. Drawing Objection**

*In the Office Action, the “drawings are objected to because they have **handwritten** annotations” and because reference characters (1), (2) and (3) are not mentioned in the description.*

Upon close inspection of the drawings, the only “**handwritten** annotations” appear to be the Figure headings (ie., FIG. 1, FIG. 2 etc.). A set of replacement sheets is submitted herewith. Each Figure heading is typewritten. No new matter was added.

The reference characters (1), (2) and (3) are mentioned in the specification, as filed, on page 4, lines 12-16. However, Applicants have amended paragraphs on pages 4 and 5 to make further reference of these characters. No new matter was added.

Accordingly, Applicants submit that they have complied with the requirements stated by the Examiner and respectfully request that the above referenced drawing objections be removed.

## **II. Claim Rejections - 35 USC §102(b)**

*In the Office Action, claims 1, 2, 6 and 7 are rejected under 35 USC §102(b) as being anticipated by U.S. Patent No. 5,248,385 issued to Powell.*

Independent claims 1, 6 and 28 have been amended to include additional claim limitations. Applicants respectfully submit that each independent claim, as amended, is patentable and not anticipated by Powell.

As a matter of basic U.S. patent law, a claim of a patent application is anticipated under 35 USC §102 only if each and every element is found described in a single prior art reference. The identical invention must be shown in as complete detail as contained in the claim. The elements identified by the reference must be arranged as required by the claim. If a prior art reference relied on in a rejection made under 35 USC §102 does not contain every element recited in the claim in as complete detail as is contained in the claim and arranged as recited in the claim, the rejection is improper and should be removed.

#### Independent Claims 1 and 28

Independent claim 1 and independent product-by-process claim 28, as amended, each requires the substrate to be a silicon carbide substrate having a 4H crystal structure. Powell fails to disclose this structural claim limitation.

Further, independent claims 1 and 28, as amended, of the present application specifically require the combination of growth on the {0001} C face of the substrate at less than 1° off the {0001} surface. In contrast, Powell discloses that “either the Si face or the C face can be polished for growth” and that an off angle of as high as 6° can be used.

However, Applicants respectfully submit that when performing epitaxial growth on a {0001} Si face, it is well known that step bunching and two-dimensional nucleation are formed during the epitaxial growth as the inclination angle of the substrate face becomes smaller, and the flatness of the epitaxial growth surface will be lost. Therefore, when using the SiC {0001} Si face inclined within the range specified by Powell, there is a drawback in that the flatness of the epitaxial growth will be lost.

To overcome this problem, the present invention is limited to using the {0001} C face of the SiC substrate. The above described defects will not occur on a substrate that is less than 1°

off from the {0001} C face of the SiC substrate. Powell fails to disclose this, and one of ordinary skill in the art reading Powell is clearly neither taught nor informed of this phenomenon. Further, Powell and/or one of ordinary skill in the art reading Powell are led to believe that the Si and C faces would be subject to substantially the same defects. Thus, claim 1 of the present application advances the art beyond that of Powell and the claims have been limited to this advancement.

Accordingly, since the crystal structure (4H) of the SiC thin film to be homoepitaxially grown of claims 1 and 28, as amended, of the present application is clearly different from that of Powell, the resulting SiC epitaxial wafer will also differ as a matter of course. In addition, while Powell inclines the SiC {0001} face at an angle of up to 6°, the inclination required by claim 1 of the present application must be less than 1°. Applicant respectfully submits that Powell fails to recognize that defects will arise bordering on whether the inclination angle is less than 1°, or 1° or greater. Clearly, Powell discloses use of inclination angles of 1° to 6° would provide the same results as inclination angles of below 1°. Accordingly, Powell and/or one of ordinary skill in the art reading Powell fails to conceive the present invention which specifically requires the combination of an inclination angle of below 1° on a {0001} C face of a SiC substrate.

For the above reasons, Applicants respectfully submit that independent claims 1 and 28 and dependent claims 17, 18, 21 and 31 are not anticipated by Powell and are patentable.

#### Independent Method Claim 6

With respect to independent method claim 6, the same issues stated above are equally applicable. In addition, the method claim further requires a step of cleansing a surface of a substrate with a mixed gas of hydrogen gas and propane gas at 1400°C to 1600°C and require that, during epitaxial growth, a source gas of silane and propane having a compositional ratio of

C and Si of 1 or less and a growth pressure of 250mbar or less are used. Applicants respectfully submit that Powell fails to disclose these method steps.

It is known that since SiC has various crystal structures, SiC having a different crystal structure will get mixed in during homoepitaxial growth of the SiC {0001} face, will partially grow heteroepitaxially, and will cause crystal defects. Powell seeks to eliminate contamination and defects of the SiC substrate by the nucleus of SiC having a different crystal structure than the SiC substrate via the use of high-temperature hydrogen gas and chlorine gas to etch the SiC substrate surface. See column 5, lines 34-36, of the Powell patent. More specifically, the conditions for the etch of Powell are “25 minutes at 1350°C, with about 6% HCl in the H<sub>2</sub> carrier gas with a flow of about 3 l/min.” (See column 5, lines 44-46, of the Powell patent.) Powell also teaches away from the use of “higher temperatures” because at “higher temperatures” etching occurs “too rapidly”. (See column 5, lines 53-54, of the Powell patent.)

In contrast, the present invention discloses heating the SiC substrate with high-frequency heating and simultaneously mixing propane gas as one of the raw material gases with hydrogen gas and flowing such mixed gas to cleanse the surface of the SiC substrate. Powell fails to disclose this process step; thus, Powell fails to disclose the limitation in claim 6, as amended, that requires cleansing a surface of a substrate with a mixed gas of hydrogen gas and propane gas at 1400°C to 1600°C. Powell also teaches away from the use of such a “higher temperature”. Unlike Powell, the present invention does not require the use or mixing of potentially harmful chlorine gas during a cleansing step.

In addition to the cleansing step required by claim 6, as amended, the present invention also reduces crystal defects by controlling epitaxial growth pressure and the composition ratio of the raw material gases. More specifically, claim 6, as amended, requires the composition ratio of

C and Si to be 1 or less during epitaxial growth, and the result is that crystal defects can be significantly reduced.

Powell teaches the introduction of 300ppm of silane gas ( $\text{SiH}_4$ ) and 120 ppm of propane gas ( $\text{C}_3\text{H}_8$ ). (See column 6, lines 13-25, of the Powell patent.) Accordingly, Powell teaches a composition ratio of C and Si of approximately 1.2 which provides a condition that is difficult for reducing crystal defects. Thus, Powell clearly fails to disclose the claim limitation of the composition ratio and clearly fails to recognize that Applicant's claimed ratio will enable crystal defects to be reduced.

For the above reasons, Applicants respectfully submit that independent method claim 6 and dependent method claim 24 are not anticipated by Powell and are patentable.

Accordingly, Applicants respectfully request reconsideration and removal of the §102(b) rejection of claims 1, 6, 17, 18, 21, 24, 28 and 31.

### **III. Conclusion**

In view of the above amendments and remarks, Applicants respectfully submit that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

Respectfully submitted,  
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